Aegis Combat System Interoperability - Designing, Building and Testing

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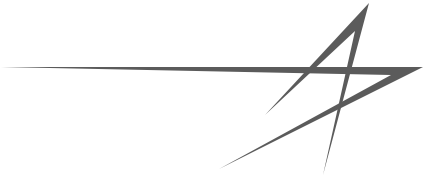
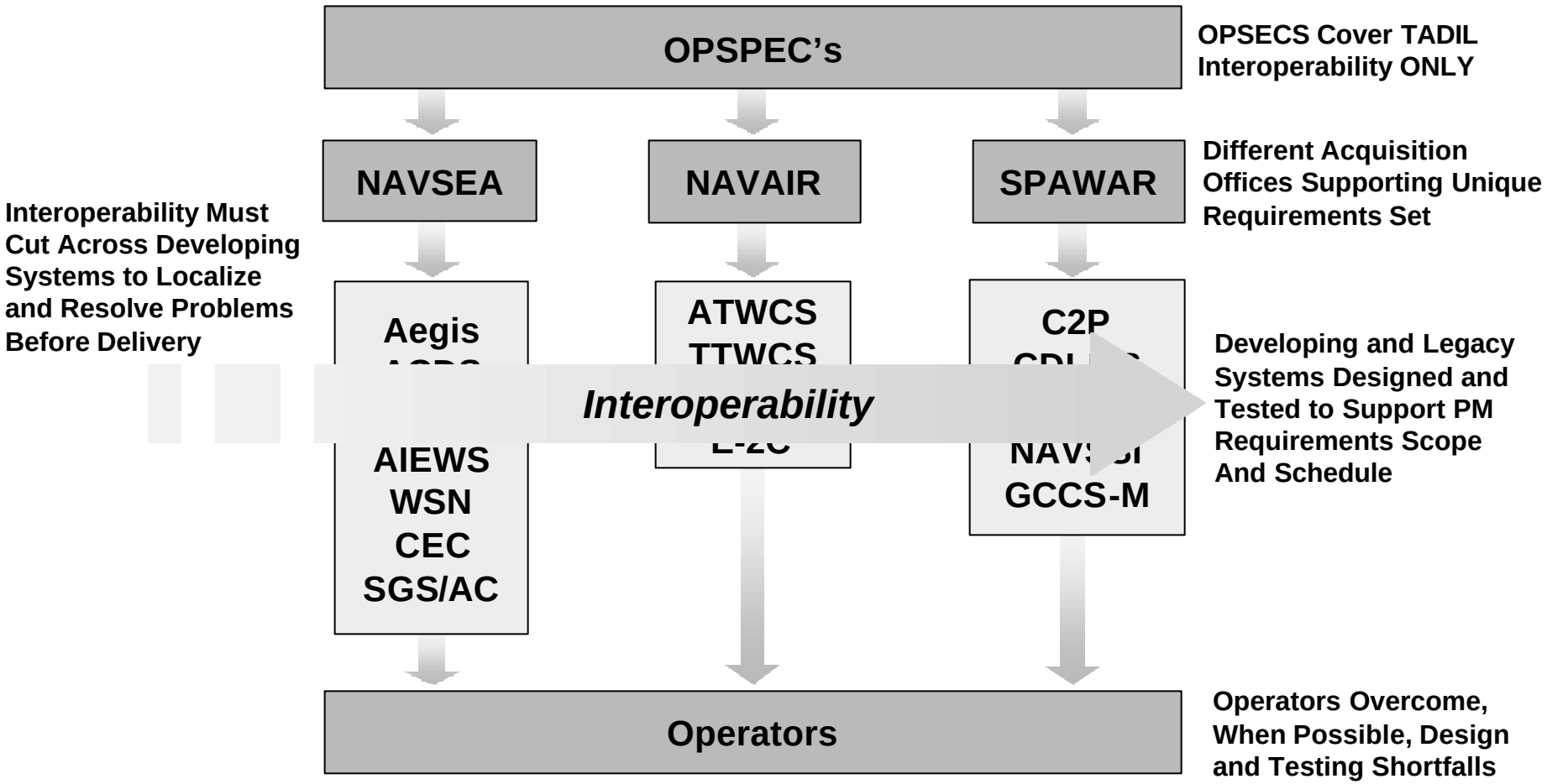
Outline



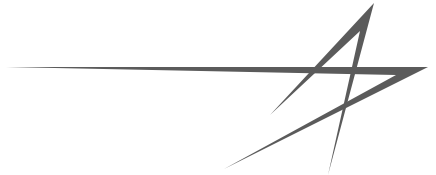
- ***Aegis Combat System Engineering Agent (CSEA) View***
- ***Aegis Baseline 6 III Interoperability Initiatives***
- ***Lessons Learned and Shortfalls***
- ***Summary***

Aegis CSEA View



System Development "Business As Usual" will <u>Not</u> Achieve Interoperability Improvement

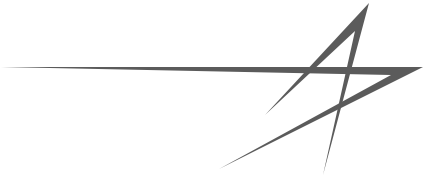
Background



- *CEC OPEVAL events led to formation of an Interoperability Task Force Senior System Engineering Council*
  - *Tasked to resolve System problems, point solution for CEC OPEVAL*
  - *ITF Link/ID/Interoperability team investigated 166 problems and corrected 38 over 17 months*
- *Concurrently PMS 400B asked, How can we improve interoperability during development?*
- *Lockheed Martin developed new test initiative to identify and correct interoperability problems during Baseline 6 Phase III development*

Interoperability Improvement Required Infrastructure and Process Changes, I.e. Not "Business As Usual"

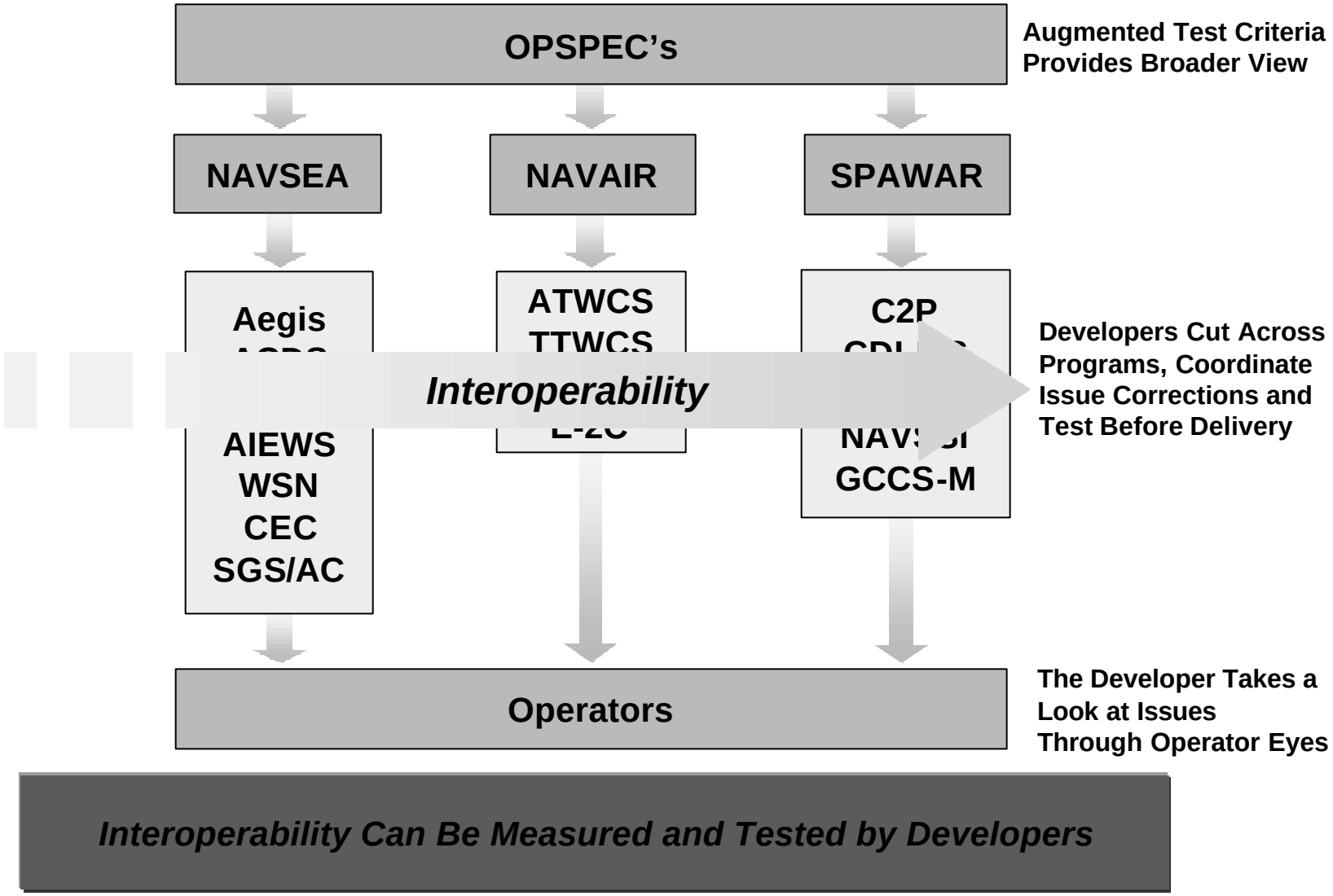
New Test Initiative – What to Do?



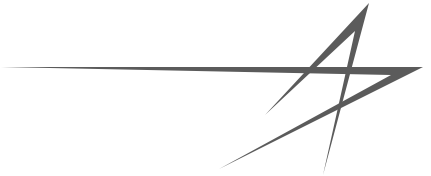
- ***Develop a system test infrastructure that would stimulate multiple systems during development***
  - ***An infrastructure that supported:***
    - ***an ability to generate and distribute common dynamic tracks to be processed by multiple systems.***
    - ***computer generated scenarios that would replicate operationally based experience.***
- ***Develop a robust test criteria with quantitative performance measurements***
- ***Develop test methodologies that facilitate:***
  - ***Iterative cross system problem identification***
  - ***Coordinated developer investigation***
  - **System wide problem resolution and validation**

Move Away From Sterile Single Ship Test Environments, Validating S/W Requirements…. Move towards Testing The Way The Ship Fights

New Test Initiative – How To Do It



Multi-Aegis Combat System (MACS)



- ***High-fidelity interoperability testing using operationally based scenarios on a distributed network***
  - ***Distribute tracks via Distribute Interface Simulator (DIS)***
  - ***Connect TADILS via Aegis Broadcast Network (ABN-16)***
  - ***Connect CEC via secure LAN***

- ***Supplements***
  - ***Navy Link Certification***
  - ***Link exercises with Patriot/THAAD,E-2, ACDS***

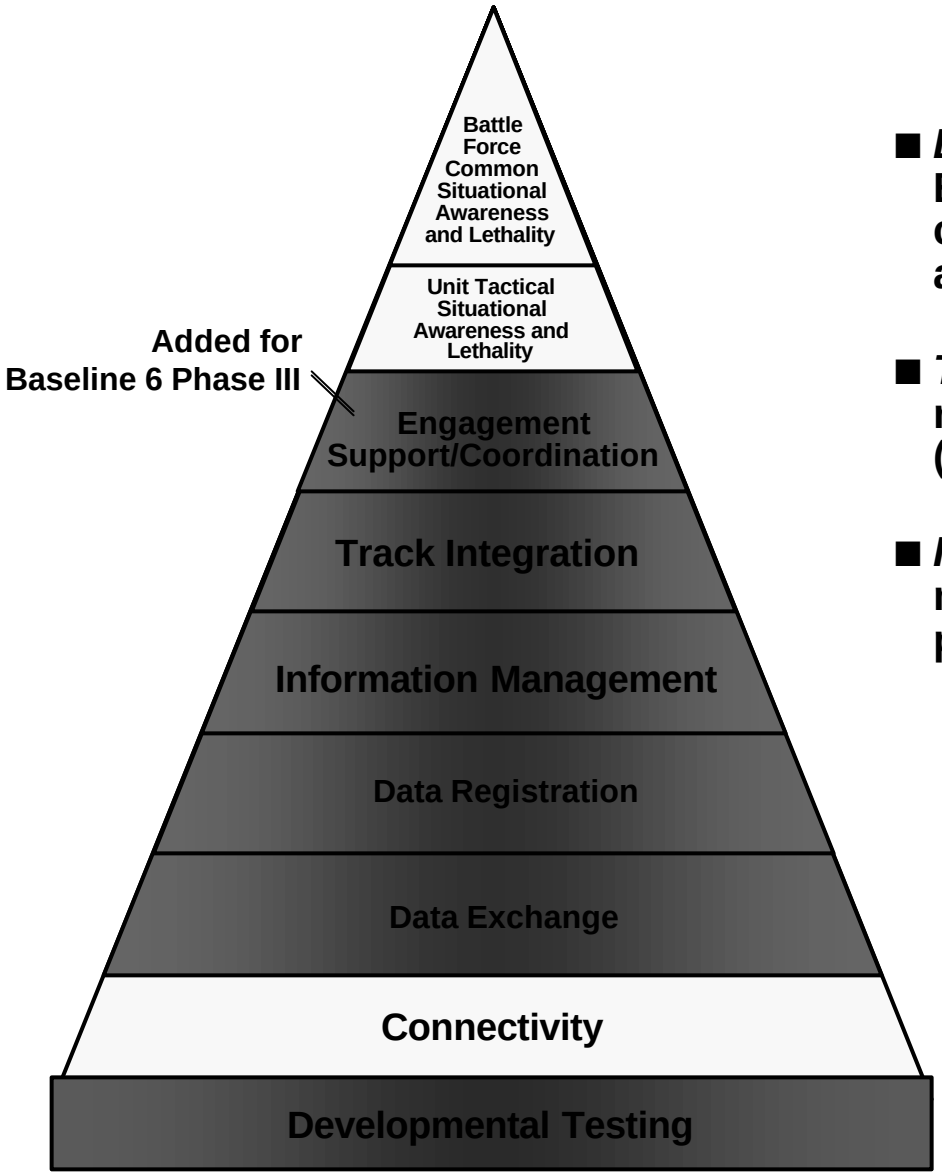
- ***Provides***
  - ***Common sensor environment***
    - ***Multi-aircraft , Multi-TBM***
    - ***Simultaneous AAW and TBM***

Built Battle Force Rancocas

Battle Force Rancocas

MACS Interoperability Test Goals

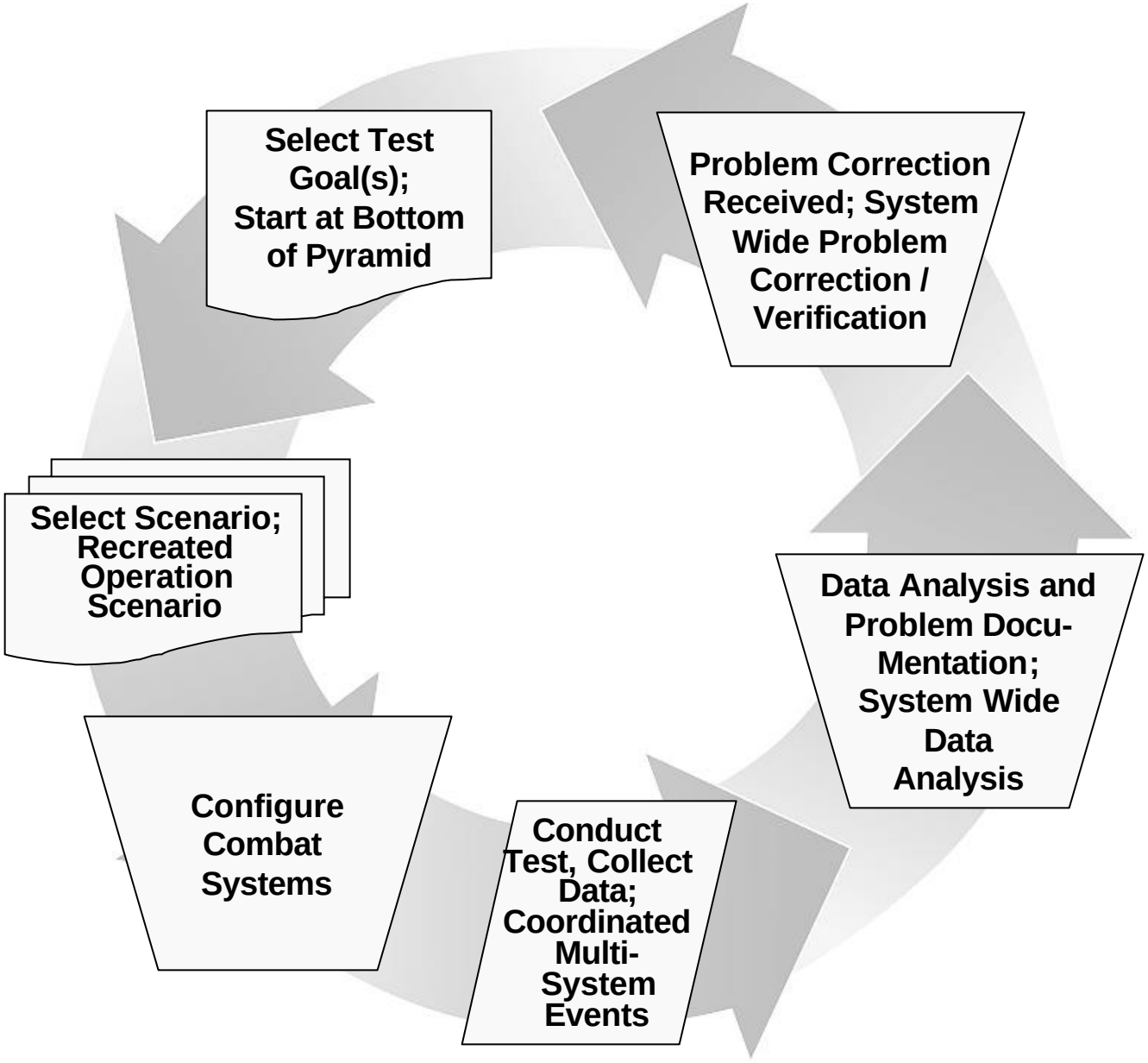
Temp 801 Based Criteria



Level Definition (Abridged)

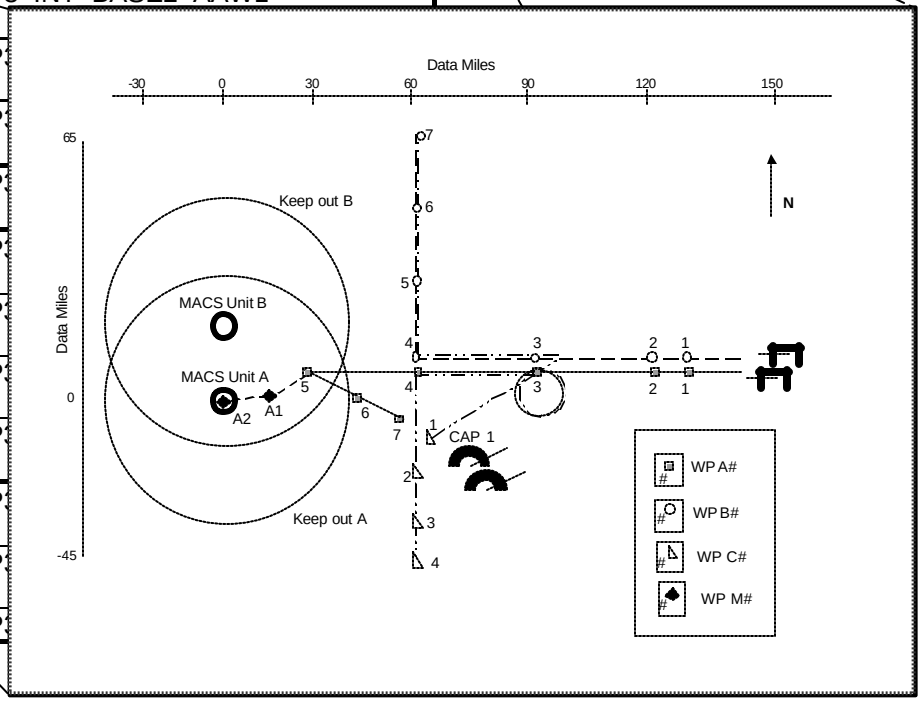
- ***Engagement Support / Coordination:*** **Exploitation of integrated tack data and connectivity to support and coordinate air / TBM engagements**
- ***Track Integration:*** **The fusion of local and remote sensor data and track parameters (correlation, decorrelation, mutual tracking)**
- ***Information Management:*** **The storage and management of local and remote track parameter data (ID, IFF, etc.)**
  - ***Data Registration:*** **The corrective alignment of local and remote track position and kinemetic data**
  - ***Data Exchange:*** **The sharing of data at the element and unit level**
  - ***Developmental Testing:*** **Verification of MACS test architecture and procedures**

Test Process



ACSIS Scenario Used for Data Registration Testing

Scenario	Permutation	Section	Recommended script name
1. Baseline AAW	**1. Single threat (bandit A)**	A2.1.1.1	6P3_INT_BASE_AAW1
1. Baseline AAW	**2. Single threat (bandit B)**	A2.1.3.1	6P3_INT_BASE_AAW2
1. Baseline AAW	**3. Dual threat (bandit A & B)**	A2.1.3.2	6P3_INT_BASE_AAW3
2. Baseline AAW mode swap	**1. Single threat (bandit A)**	A2.2.1.1	6P3_INT_BASE2_AAW1
2. Baseline AAW mode swap	**2. Single threat (bandit B)**	A2.2.3.1	6P3
2. Baseline AAW mode swap	**3. Dual threat (bandit A & B)**	A2.2.3.2	6P3
3. Dual-Axis AAW threat	**N/A**	A2.3	6P3
4. Modified Dual-Axis AAW threat	**1. Single ASCM salvos**	A2.4	6P3
4. Modified Dual-Axis AAW threat	**2. Two ASCM salvos**	A2.4	6P3
4. Modified Dual-Axis AAW threat	**3. Three ASCM salvos**	A2.4	6P3
4. Modified Dual-Axis AAW threat	**4. Four ASCM salvos**	A2.4	6P3
5. Baseline HVA AAW	**1. Two ASCM salvos**	A2.5	6P3
5. Baseline HVA AAW	**2. Four ASCM salvos**	A2.5	6P3
5. Baseline HVA AAW	**3. Six ASCM salvos**	A2.5	6P3



Data Registration Testing:

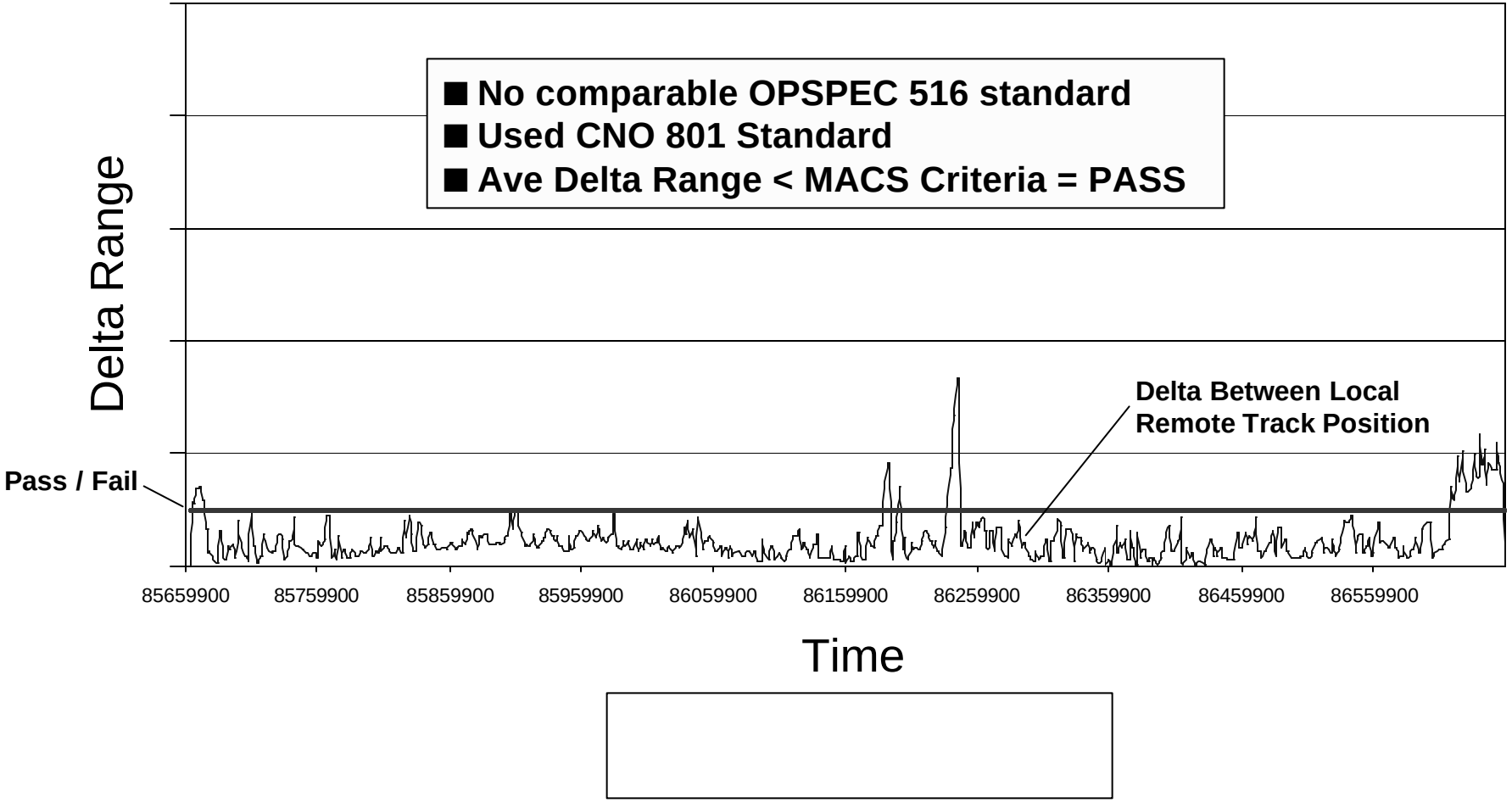
An Example

- ***MACS test matrix identifies 11 priority link specific data registration test goals and pass / fail criteria for:***
  - ***Relative Gridlock***
  - ***IU Registration***
  - ***Sensor Registration***
  - ***Developed ACSIS DIS scenario to inject sensor error that requires compensation using data registration***

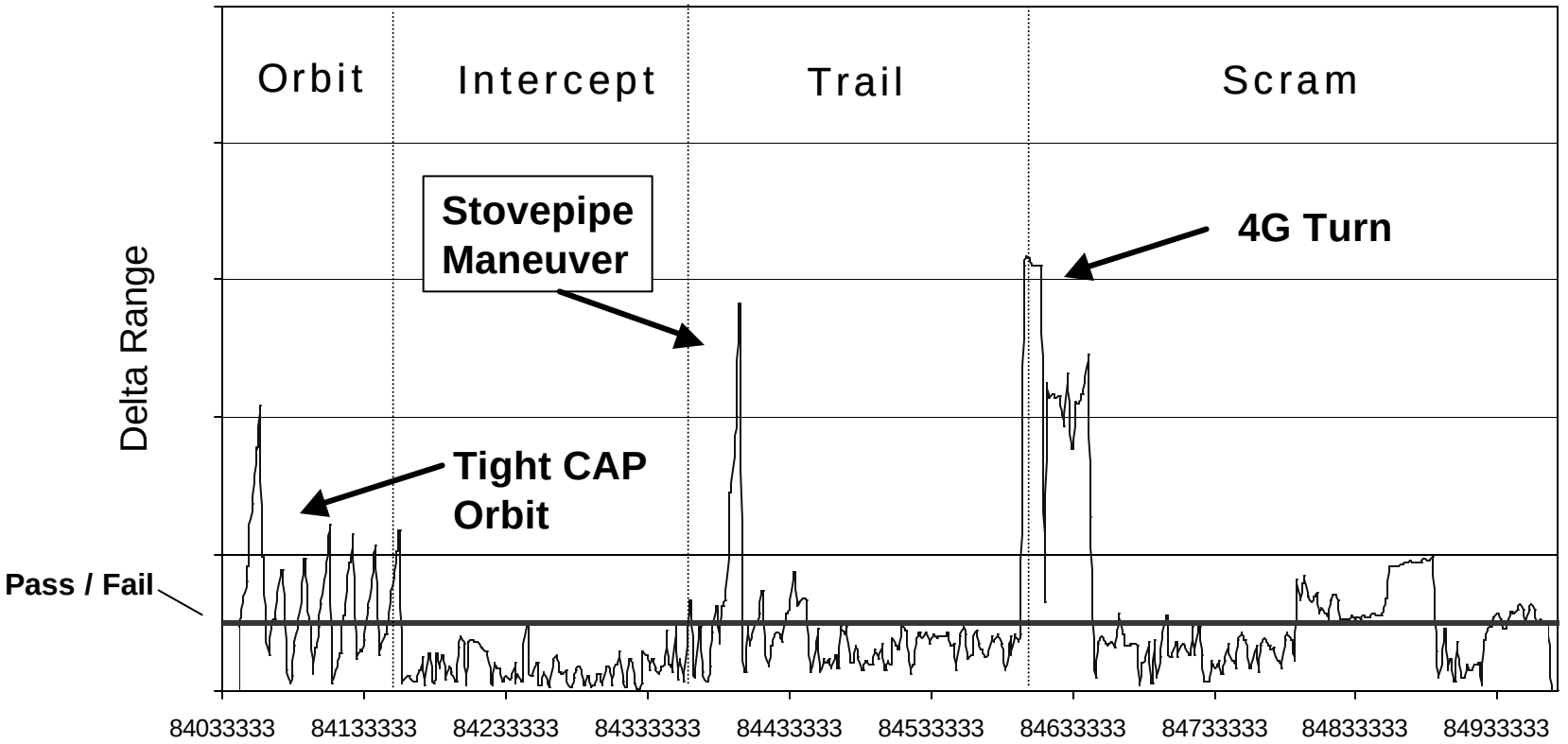
- ***Initial results***
  - *Failed on visual inspection:* ***Tracks jumped wildly while conducting relative gridlock throughout scenario***
  - ***Data analysis identified C2PR N-1-3033, SGS / AC Sensor Registration application and C&D program problems***
  - ***All fixes verified***
  - ***Basic Relative Gridlock, IU Registration, and Sensor Registration functionality passed***

Success Story, But Required Five Month Iterative Process

Relative Gridlock Test Result: Aegis-Aegis Mutual Track

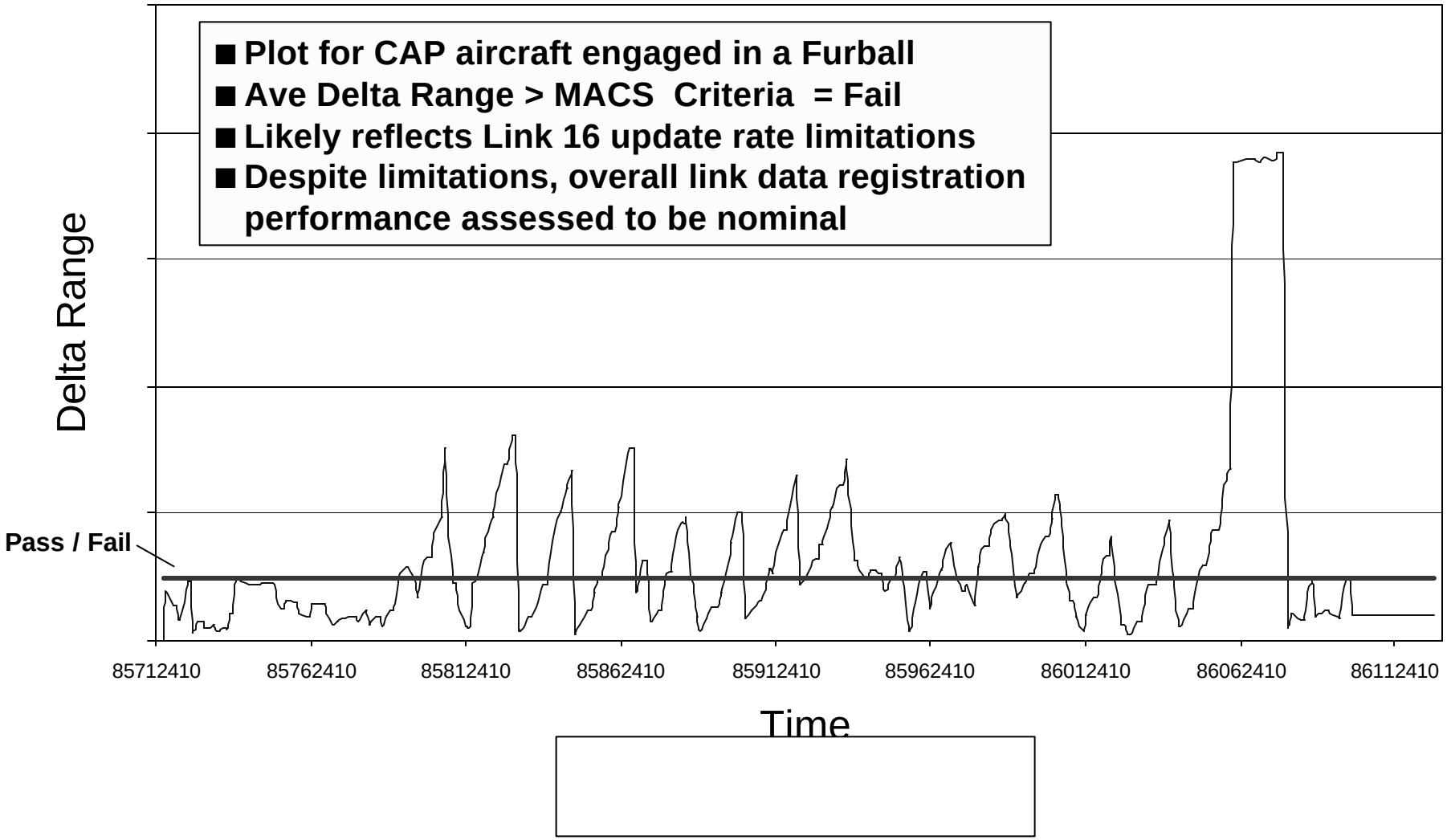


Sensor and IU Registration Results

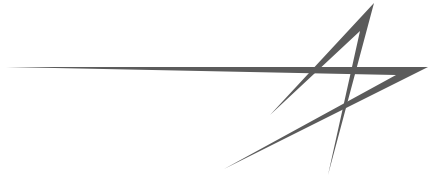


- Maneuvering CAP aircraft
- Avg Delta Range < MACS Criteria = PASS

Sensor and IU Registration Limitations



MACS Lessons Learned



- ***Developmental testing should be conducted in small doses with limited objectives***
- ***Test configuration very challenging***
  - ***Most resource intensive test configuration we employ***
  - ***Developmental testing demands large test time investment per test objective***
- ***Test architecture needed thorough testing and debugging***
- ***Testing generates heavy data analysis demands***
- ***DIS essential for TBMD interoperability testing***

Finding and Fixing Interoperability Problems is an Iterative Time Consuming Process

Summary

- ***Lockheed Martin NE&SS-Surface Systems initiated MACS testing in response to PMS 400B direction to "improve interoperability"***
- ***Infrastructure developed and testing in progress***
- ***Experienced growing pains***
- ***Testing has exposed problems that otherwise would be difficult to find or collect data on***
- ***The use of DIS architecture has proven a necessity for TBMD interoperability testing***
- ***Test shortfalls that affect ability to find and quickly resolve problems***
  - ***Architecture / equipment***
  - ***Analysis tools***
  - ***Availability / participation of all elements developers***

Interoperability is Not a Goal, It's a Process